Stabilisation of unbound granular layers – reinforcement required?

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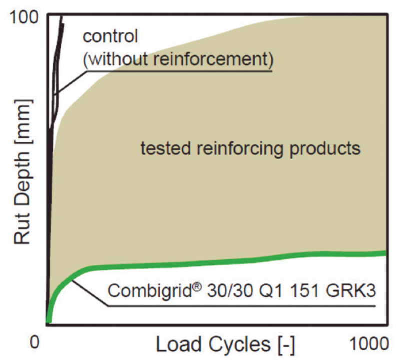

Figure 1 - *Outstanding performance of a biaxial geogrid in a performance-related test setup (after Christopher et al., 2008).*

The behaviour of unbound base courses is improved by the use of geogrids. The latest results from large-scale testing carried out by e.g. Cuelho & Perkins (2009) show the effects of different geogrid products as well as performance-related tests by e.g. Christopher et al. (2008). Some prod-ucts provide characteristics for an ideal support of a ductile behaviour of unbound granular layers and reduced rutting (figure 1).

Usually the behaviour of the reinforcement is defined by the simplification of compound effect and membrane theory. The compound effect is the basis for the composite of reinforcement and surrounding soil while the membrane effect provides the ability for absorbing tensile forces:

- A product which provides only an outstanding interaction with the surrounding soil can first provide a beneficial stabilisation effect when movement of the grain structure takes place and shear-strain is restrained by the absorption of tensile forces.
- A product which provides high tensile strength to act as a membrane cannot mobilise its strength if no interaction with the surrounding soil is given. The latter would only take place at great deformation of the structure when the soil has already failed due to large shear displacements.

That leads to the logical conclusion: Both effects for themselves cannot provide stabilisation or reinforcement of the granular layer; it is the combination and interaction of both which results in the beneficial effects of a suitable reinforcement product (figure 2).

Not only thin and unpaved granular layers lead to plastic strains in the reinforcement product. Also in relatively stiff constructions (e.g. base courses for paved roads) plastic strains are documented, also considering that these are relatively low compared to the elastic strains (Vollmert, 2013). The plastic strains are the result of the construction stage (trafficking and compaction), when the bearing capacity of the layers is initially relatively low and supplemented by plastic strains accumulated during service life.

To restrain the amount of plastic strains – even when occurring at low strain of some per mill – the absorption of tensile forces is necessary and supplementary performance reliability of tensile strength should be provided (figure 3).
Relaxation and creep should be discussed to withstand even small plastic deformations.

The design goal for a good performance of a product is the optimal combination of the main parameters as interaction behaviour (by friction and interlocking), radial stiffness and absolute tensile strength (to provide satisfactory robustness), even under long-term aspects. Therefore, effective and long-term reliable stabilisation of unbound granular soils and layers requires beneficial geosynthetic reinforcement as defined in international standards and regulations. ●

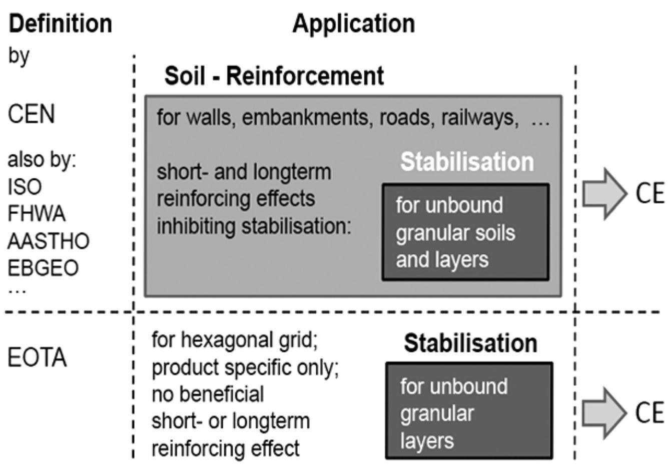

Figure 2 - *Definition of stabilisation with or without beneficial reinforcing effect.*

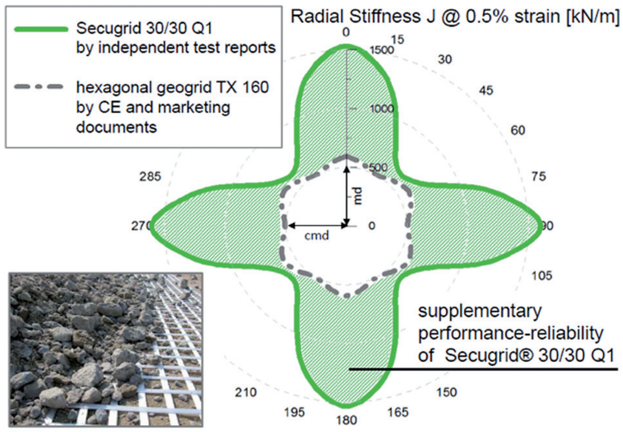

Figure 3 - *Radial stiffness of different geogrids and supplementary performance reliability.*